REMARKS:

Applicant has amended claims 1-10 and cancelled claims 11-12, and 21-28 (claims 13-20 were cancelled in an earlier Response). Applicant reserves the rights to reintroduce the cancelled claims in a future Continuation Application or a Continuation-In-Part Application. Applicant has also added new claims 29-43. Applicant believes that no new subject matter has been introduced.

ARGUMENTS:

I.

The Examiner rejected Claim 1 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr et al (US 2002/0189637).

The Examiner stated the following in Section 2 (on pg. 2) of his Office Action mailed 1/25/2007:

> *Applicant's remarks with respect to at least claims 4 and 9 with respect to lack of motivation from Downes, Jr et al to perform the wetting and electroplating steps with the same solution is found persuasive and the rejection grounds of claims 4 and 9 utilizing Downes, Jr et al have been withdrawn.*

Applicant has amended Claim 1 to include a limitation from Claims 4 and 9 that is relevant to the Examiner's statement above. Specifically, Applicant has amended Claim 1 to include the limitation from Claims 4 and 9 of "wherein the activation or wetting solution is the same as the electrolyte." In addition, Applicant has amended Claim 1 to add the further limitation that "steps (a), (b). (c), and (d) are performed in the same chamber."

Thus, in light of the above, Applicant respectfully submits that Claim 1 is patentable over Tzanavaras et al in view of Downes et al. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

II.

The Examiner rejected Claims 2, 3, 7, 8, 10, 21-22, and 25 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Downes, Jr et al (US 2002/0189637), as applied to Claim 1 above, and further in view of Langner et al (US 4,834,842).

Applicant respectfully submits that Langner et al discloses the use of at least one inhibitor additive for electroplating. However, Applicant respectfully submits that Langner et al discloses nothing regarding (a) wetting or activation by ultrasonic or megasonic vibrations, or (b) applying high pressure jets of an electrolyte to a substrate.

A. Regarding Claim 2: Applicant repeats the discussion in Section **I** above which shows that amended Claim 1 is patentable over Tzanavaras et al in view of Downes et al. Further, because Langner et al discloses nothing regarding either wetting or activation by ultrasonic or megasonic vibrations, or applying high pressure jets of an electrolyte to a substrate, Applicant submits that Claim 1 is also patentable over Tzanavaras et al in view of Downes et al and further in view of Langner et al. Thus, Applicant submits that since Claim 2 depends from claim 1, it is also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

B. Regarding Claim 3: Applicant has amended Claim 3 to depend directly from Claim 1. As such, amended Claim 3 does not require that the electrolyte comprises at least one inhibitor additive. Applicant repeats the discussion in Section **I** above which shows that amended Claim 1 is patentable over Tzanavaras et al in view of Downes et al. Further, because Langner et al discloses nothing regarding either wetting or activation by ultrasonic or megasonic vibrations, or applying high pressure jets of an electrolyte to a substrate, Applicant submits that Claim 1 is also patentable over Tzanavaras et al in view of Downes et al and further in view of Langner et al. Thus, Applicant submits that since amended Claim 3 depends from claim 1, it is also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

C. Regarding Claims 7, 8, 10, 21, 22, and 25: Applicant has cancelled Claims 21, 22, and 25, and has amended Claims 7, 8, and 10. Amended Claims 7, 8, and 10 depend from amended Claim 2. Applicant repeats the discussion regarding Claim 2 in Section **IIA** above which shows that Claim 2 is patentable over Tzanavaras et al in view of Downes et al and further in view of Langner et al. Thus, Applicant submits that since amended Claims 7, 8, and 10 depend from amended Claim 2 they are also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

D. Regarding Claims 3, 8, and 10: Applicant has amended Claims 3, 8, and 10. Regarding amended Claim 3, Applicant repeats the discussion in Section **IIB** above, which shows that

amended Claim 3 is patentable over Tzanavaras et al in view of Downes et al and further in view of Langner et al. Regarding amended Claims 8 and 10, Applicant repeats the discussion in Section **IIC** above, which shows that amended Claims 8 and 10 are patentable over Tzanavaras et al in view of Downes et al and further in view of Langner et al. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

III.

The Examiner rejected claim 1 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Hackett (US 5,368,634).

A.

The Examiner stated in his Office Action of 1/25/200 (at the bottom of page 7): "*Thus, it would have been within the expected skill of a routiner in the art to have incorporated the vacuum and ultrasonic structures into the electroplating cell of Tzanavaras et al to allow the wetting process of Hackett to occur without the need for transferring the substrate from one chamber to another.*"

Applicant has amended Claim 1 to include the limitations of: (i) using the same electrolyte as the wetting or activation solution, and (ii) that all the steps are performed in the same chamber. As such, Applicant respectfully submits that amended Claim 1 is patentable over Tzanavaras et al in view of Hackett because it includes the limitation that both the wetting (by ultrasonic or megasonic vibrations) step, and the electroplating step, are performed in the same chamber.

Applicant respectfully submits that Hackett teaches a method for removing gases from small cavities in a substrate by covering the substrate with an electrolyte, and applying repeated cycles of vacuum and venting the electrolyte. For example, see col. 2, lines 4-20:

> *In accordance with the invention, a method for removing gases from small cavities in an article comprises the steps of providing an article with a cavity in a surface thereof, providing a liquid medium, and covering the surface of the article with the liquid medium. The method further includes drawing a vacuum on the liquid medium and applying a mechanical impulse to the article. The mechanical impulse is preferably applied by rapidly venting the vacuum to air, so that the change in pressure over the liquid medium is propagated to the cavities to encourage the bubbles to grow and eventually to float free of the article. The steps of applying a vacuum and venting are preferably repeated in*

sequence through at least several cycles, with the bubbles growing and becoming less firmly attached to the surface of the article with each cycle.

Hackett further discloses (at col. 4, lines 31-40):

The preferred approach of the invention, involving cyclic application of vacuum and venting to atmosphere, does not require special equipment for applying the mechanical impulse. The vacuum is preferably a standard laboratory vacuum available from a mechanical forepump. This vacuum can readily be provided to a sealed cell which contains the article to be degassed. It is not necessary to provide special mechanical vibrators or ultrasonic equipment, although the invention in other embodiments can employ these alternative approaches.

As the Examiner can readily appreciate from this, Hackett teaches the use of ultrasonic or other mechanical impulses **only** in combination with a cyclic application of vacuum and venting. As such, one of ordinary skill in the art would understand that the use of ultrasonic impulses by itself would not provide wetting. In addition, Hackett teaches the use of separate chambers for wetting and for electroplating (see, for example, FIG. 4; col. 4, lines 26-29; and col. 5, line 60 through col. 6, line 6). Specifically, Hackett teaches a specially designed vacuum chamber (cell 30 in FIG. 2; and col. 3, lines 36-59) for wetting, and a separate chamber (electroplating cell 60 in FIG. 3; and col. 4, lines 27-40) for electroplating.

Thus, in light of the above, and as the Examiner has recognized, if one of ordinary skill in the art were to combine the teachings of Tzanavaras et al and Hackett, that person of ordinary skill in the art would add a vacuum and venting capability **and** an ultrasonic capability to the electroplating chamber of Tzanavaras et al. However, Applicant respectfully submits that a person of ordinary skill in the art would understand, from Hackett's teachings and from knowledge well known in the field of electroplating, that separate chambers are necessary because the electroplating chamber of Tzanavaras et al is incompatible with vacuum application. In particular, the electroplating chamber is incompatible with vacuum application because it is not sealed for maintaining vacuum. For example, Tzanavaras et al shows an unsealed electroplating cell (tank) 12 (at FIG. 1; col. 4, lines 25-33). The cell is open from above to facilitate the introduction and removal of the wafer. As such, Tzanavaras et al's electroplating cell is not sealed, and is incompatible with vacuum application.

Although an electroplating cell might conceivably be fitted to maintain vacuum, Applicant respectfully submits that it would require modifications that are **beyond** routine work

of a person of ordinary skill in the art. Thus, because the modifications would require more than routine work by one of ordinary skill in the art, Applicant submits that claim 1 is patentable over Tzanavaras et al. in view of Hackett.

In particular, converting Tzanavaras et al's jets electroplating chamber to enable vacuum operation would require the addition of complicated and costly modifications for introducing and removing a wafer, and for rotating the anodes/jets assembly. This would require a special (and cumbersome) wafer handling, including a costly gate valve which is compatible with vacuum operation, and which would resist the corrosive activity of an electroplating solution. Similarly, such modifications would also require a conductive rotating seal which is compatible with vacuum operation, and which would resist the corrosive activity of the electroplating solution. These problems can only be solved by work which is beyond the routine work of a person of ordinary skill in the art because vacuum gate valves are typically constructed of metals which are susceptible to corrosion in electroplating solutions. Similarly, rotating seals are typically not compatible with both vacuum and electroplating solutions. To further appreciate the difficulties involved in combining vacuum application with an electroplating cell, Applicant has attached below an IDS with an article entitled "Silicon Epitaxial Growth by Electrodeposition from Molten Fluorides" by U. Cohen et al., in Journal of Electrochemical Society, Vol. 123(3), pp. 381-383, March 1976. Applicant respectfully submits that the article does not disclose or show rotating jets and/or a conductive rotating seal, such as required in Tzanavaras et al's electroplating cell.

Thus, in light of the above, Applicant respectfully submits that one of ordinary skill in the art, after reading Tzanavaras et al and Hackett, would not be motivated to combine the teachings of the references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

B.

The Examiner asserts that a motivation for one of ordinary skill in the art to combine the references (Tzanavaras et al and Hackett) is: "*[t]he ultrasonic vibrations would have increased wetting of the blind vias having diameters in the range of 10-30 micrometers present on the substrates of Tzanavaras et al.*"

On the contrary, Applicant respectfully submits that not only Tzanavaras et al does not provide any motivation to combine its teaching with that of Hackett, Tzanavaras et al actually

teaches away from the invention of (amended) Claim 1. As set forth in Ormco Corp. v. Align Technology Inc., 463 F3d 1299 [79 USPQ2d 1931] (Fed. Cir. 2006) at 1940:

> However, a reference that "teaches away" from a given combination may negate a motivation to modify the prior art to meet the claimed invention. See, e.g., *Medichem, S.A. v. Rolabo*, S.L., 437 F.3d 1157, 1165 [77 USPQ2d 1865] (Fed. Cir. 2006). 'A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.' *In re Kahn*, 441 F.3d at 990 (quoting *In re Gurley*, 27 F.3d 551, 553 [31 USPQ2d 1130] (Fed. Cir. 1994)) (internal quotation marks omitted).

Tzanavaras et al asserts (at column 3, lines 13-22): "*The impinging powerful jets create turbulent flow at the substrate's surface, thus providing efficient agitation and replenishment in all areas, including complex mask features with varying depth and opening sizes. High aspect ratio opening areas receive a similar degree of agitation (and replenishment) as areas of lower aspect ratios. Even features with the deepest and smallest openings (having the highest aspect ratio) receive essentially the same degree of agitation as areas of lower aspect ratios.*"

One of ordinary skill in the art would understand from the above that the application of electrolyte jets to the substrate facilitates good agitation (and wetting) inside even the deepest and smallest openings (having the highest aspect ratios). Furthermore, since Tzanavaras et al teaches that the jets alone accomplish such good agitation (and hence wetting) inside the low and high aspect ratio openings, that person of ordinary skill in the art would also understand that using any extra means (such as ultrasonic) to improve wetting would be superfluous, and would unnecessarily increase the number of processing steps, complexity, and cost. Therefore, one of ordinary skill in the art, upon reading Tzanavaras et al, would be led in a direction **divergent** from the path that was taken by the Applicant in (amended) Claim 1 (which requires ultrasonic or megasonic vibrations in order to wet the openings). Furthermore, a person of ordinary skill in the art, upon reading Tzanavaras et al's teaching, would be **discouraged** from following the path set out in (amended) Claim 1. Thus, Tzanavaras et al. teaches away from the path taken by Applicant. Thus, because Tzanavaras et al teaches away from Claim 1, it negates a motivation to modify any prior art (including Hackett) to meet Claim 1. As such, Applicant respectfully submits that (amended) Claim 1 is not obvious over Tzanavaras et al in view of Hackett.

IV.

The Examiner rejected claims 2-5, 7-11, and 21-28 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Hackett (US 5,368,634), as applied to claim 1 above, and further in view of Langner et al (US 4,834,842) with evidence from Downes, Jr et al (US 2002/0189637, for Claims 22 and 24 only).

A. Regarding Claim 2: Applicant repeats the discussion regarding Claim 1 in Sections **IIIA** and **IIIB** above, showing that Claim 1 is allowable over Tzanavaras et al in view of Hackett. Further, because Langner et al discloses nothing regarding either wetting or activation by ultrasonic or megasonic vibrations, or applying high pressure jets of an electrolyte to a substrate, Applicant submits that Claim 1 is also patentable over Tzanavaras et al in view of Hackett and further in view of Langner et al. Thus, Applicant submits that since Claim 2 depends from Claim 1, it is also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

B. Regarding Claims 3-5, 7-11, and 21-28: Applicant has cancelled Claim 11, and 21-28, and has amended Claims 3-5, and 7-10. Amended Claims 3-5 depend directly from amended Claim 1, and amended Claims 7-10 depend from amended Claim 2.

Applicant repeats the discussion regarding Claim 1 in Sections **IIIA** and **IIIB** above, which shows that amended Claim 1 is patentable over Tzanavaras et al in view of Hackett. Thus, Applicant submits that since amended Claims 3-5 depend from Claim 1, they are also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

Applicant repeats the discussion regarding Claim 2 in Section **IVA** above, which shows that amended Claim 2 is patentable over Tzanavaras et al in view of Hackett and further in view of Langner et al. Thus, Applicant submits that since amended Claims 7-10 depend from amended Claim 2, they are also patentable over these references. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

C. Regarding Claims 7, 21, 23, 25, and 27: Claims 21, 23, 25, and 27 have been cancelled, and Claim 7 has been amended. Applicant repeats the discussion of Claims 7 in Section **IVB** above. Applicant respectfully submits that, for at least the same reasons discussed in Section **IVB** above, amended Claim 7 is patentable over Tzanavaras et al in view of Hackett and further in view of Langner et al. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

Note: Applicant respectfully submits that the Examiner's assertion that Tzanavaras et al teach (in Example 1) exposed metallic surface on the field and sidewalls, is incorrect. Please refer to Comment **1** in the **COMMENTS** below.

D. Regarding Claims 3, 8, and 10: Claims 3, 8, and 10 have been amended. Regarding amended Claims 3, 8, and 10, Applicant repeats the discussion in Section **IVB** above, which shows that amended Claims 3, 8, and 10 are patentable over Tzanavaras et al in view of Hackett et al and further in view of Langner et al. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

E. Regarding Claims 4, 5, 9, and 11: Claims 4, 5, 9, have been amended, and Claim 11 has been cancelled. Regarding amended Claims 4, 5, and 9, Applicant repeats the discussion in Section **IVB** above, which shows that amended Claims 4, 5, and 9 are patentable over Tzanavaras et al in view of Hackett et al and further in view of Langner et al. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

E. Regarding Claims 22 and 24: Claims 22 and 24 have been cancelled.

F. Regarding Claims 26 and 28: Claims 26 and 28 have been cancelled.

V.

The Examiner rejected Claims 6 and 12 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al (US 5,421,987) in view of Hackett (US 5,368,634), and Langner et al (US 4,834,842) as applied to claims 5 and 11 above, and further in view of Reynolds (US 5,904,827).

Applicant respectfully submits that Reynolds discloses a megasonic transducer (90 in FIG. 3) for agitating the electrolyte during the electroplating (see col. 8, lines 49-52). However, Reynolds does not disclose a (megasonic or ultrasonic) wetting step prior to the electroplating step.

A. Regarding Claims 6 and 12: Claims 12 has been cancelled and Claim 6 has been amended to depend directly from Claim 1. Applicant repeats the arguments regarding Claim 1 in Sections **IIIA** and **IIIB** above, showing that Claim 1 is allowable over Tzanavaras et al in view of Hackett. Applicant respectfully submits that, since Claim 6 depends from allowable Claim 1, it is also patentable over Tzanavaras et al in view of Hackett, for at least the same reasons. Furthermore, the addition of Langner et al and Reynolds does not affect, whatsoever, the allowability of claim 1. Therefore, Applicant respectfully submits that amended Claim 6 is

patentable over Tzanavaras et al in view of Hackett and Langner et al, and further in view of Reynolds. As such, Applicant respectfully requests the Examiner to withdraw this rejection.

Summary: Applicant respectfully submits that for at least the reasons stated above, claims 1-11 and 29-39 are allowable over all cited arts, separately, or in any combination thereof.

COMMENTS

1. The Examiner stated that Tzanavaras et al teach (at Example 1) that the sputter deposited seed layers coated the field and the sidewalls of the openings. Applicant wishes to clarify the record on this point and correct a misunderstanding. Specifically, Applicant submits that, regarding Example 1, Tzanavaras et al states (at col. 9, lines 6-10) that the seed layer was deposited on a flat surface (without openings): "*The substrate was a flat square ceramic wafer with dimensions of 4.5" on the side, and 0.105" thick. It was metallized prior to plating by sputter deposition of 1,000 Å thick Ni-Fe seed layer on the front surface.*" This is further clarified, as Tzanavaras et al goes on to describe (at col. 9, lines 58-61) a successive experiment, in which the wafer had a photoresist mask (coated and patterned over the flat seed layer): "*Further improvements on a surface of a substrate patterned with a photoresist mask having a variety of feature openings with aspect ratios ranging from 1:10 or less to 3:1 or greater*". Such a photoresist mask has only exposed metallic surface at the bottom surface of the openings. The sidewalls and the field of the photoresist mask are non-metallic. Further, in describing the background of its invention, Tzanavaras et al states (at col. 1, lines 21-31): "*When plating an alloy through a patterned mask, such as a photoresist mask, composition non-uniformity is often encountered among opening areas of different aspect ratios. ... An example of such a situation is the plating of Ni-Fe (permalloy) through a patterned photoresist mask in the course of manufacturing Thin Film Heads (TFH) or Magnetic Bubbles.*"

2. The Examiner stated that Downes et al teach vias having metallic bottom surface and non-metallic sidewall surfaces made by drilling through a printed circuit board with a metallic bottom surface. Again, Applicant wishes to clarify the record on this point and correct a misunderstanding. The drilled holes of Downes et al are through-holes, as evidenced, for example, in Paragraphs [0003] and [0033], and, as such, have no bottom surface.

3. The Examiner stated in Section 9 (on page 9) that the Declaration filed by Applicant on 22 December 2006 was insufficient to overcome the rejection of Claims 1 and 7 based upon Tzanavaras et al in view of Downes, Jr et al. The Examiner further stated that: "*It is noted that the problem here is the use of relative terminology. When comparing the actual sizes disclosed by Downes, Jr et al (see col. 1) of 0.001-0.002 inches (25.4-50.8 micrometers) and by Applicant (see declaration) of 17 and 55 micrometers, it is clearly evident that the difficulty in wetting noted by Downes, Jr et al is the same difficulty in wetting noted by Applicant since both Downes,*

Jr et al and Applicant note the problem in holes/vias of the same size. Therefore, Applicant's comparison data with respect to the wetting problem being for different sizes is not found persuasive." Applicant respectfully submits that his declaration covered the range of 6-55μm, not 17-55μm. Thus the lower end of Applicant's range (6μm) was 4 times smaller than the lower end of Downes, Jr et al (25.4μm). The effect of increasing wetting difficulty with the increasing width of the openings becomes more apparent (in the Figures and Table I of the Declaration) when comparing the results of 6μm vias (~100% wetted fraction) with 55μm vias (~48% wetted fraction). The wetting difficulty effect is very small or not apparent when comparing the 17μm vias (~50%) against 55μm vias (~48%). Applicant still maintains that Downes, Jr et al teaches the opposite, that the wetting problem is more prevalent for narrower (higher aspect ratio) openings than for wider (lower aspect ratio) openings. Furthermore, Applicant submits that Hackett also teaches that the wetting problem is more prevalent for the narrower openings than for the wider ones. See, for example, Hackett at col. 1, lines 33-36: "*The smaller the vias in diameter and the longer their lengths relative to their diameters, the more likely that bubbles remain in the vias after immersion.*" See also Hackett col. 1, lines 55-56: "*The larger the diameter of the via, the easier it is to remove bubbles.*"

Respectfully submitted,

Dated: 6/7/2007

By _____
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